Appendix I

Geophysical Survey Letter Report

Northwest Boundary Area RCRA Facility Investigation
Fort Buchanan, Puerto Rico

EA Engineering, Science,
and Technology

Woodbridge Office Center
1319 Woodbridge Station Way
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7 August 2008

Mr. Timothy Rodeffer
U.S. Army Environmental Command
5179 Hoadley Road, Building E4480
Aberdeen Proving Ground, MD 21010

RE: Geophysical Investigation, Fort Buchanan, Puerto Rico

Mr. Rodeffer:

A geophysical investigation was conducted to the east of the DPW complex at Fort Buchanan from 21-23 July 2008. The investigation targeted the area around monitoring well MW-15 (Figure1) that has historically been found to have the highest groundwater concentration of TCE (374 µg/L). The enclosed report authored by Earth Resources Technology, Inc. (ERT) provides details related to the investigation, the technologies used in the field, and the results.

Three technologies were utilized in a grid approximately 300-by-300 ft in area. The investigation included a magnetometer survey, an electromagnetic (EM) survey, and a ground penetrating radar (GPR) survey. The magnetometer and EM surveys were conducted across the entire grid area while the GPR survey was performed to further investigate the anomalous areas detected using the first two technologies.

Results of the investigation indicated that two main anomalous areas exist in the subsurface. These are 'Anomaly A,' located in the northwest corner of the grid, and 'Anomaly B', located in the fenced area to the south of MW-20. Other anomalies could be generally explained by identified surface or subsurface features. Anomaly A is the larger of the two, and is roughly 150-by-90 ft in area. While it is unknown what comprises the anomaly, it is likely subsurface metallic debris buried in trenches or depressions. Anomaly B is approximately 10-by-10 ft in area and is located adjacent to the old railroad line. Both anomalies appear to be shallow (within 4-ft of ground surface).

The nature of the anomalies cannot be confirmed without additional intrusive investigation. It is anticipated that a fifth addendum to the *Northwest Boundary Investigation Work Plan* will include some intrusive characterization activities in the vicinity of the identified anomalies.

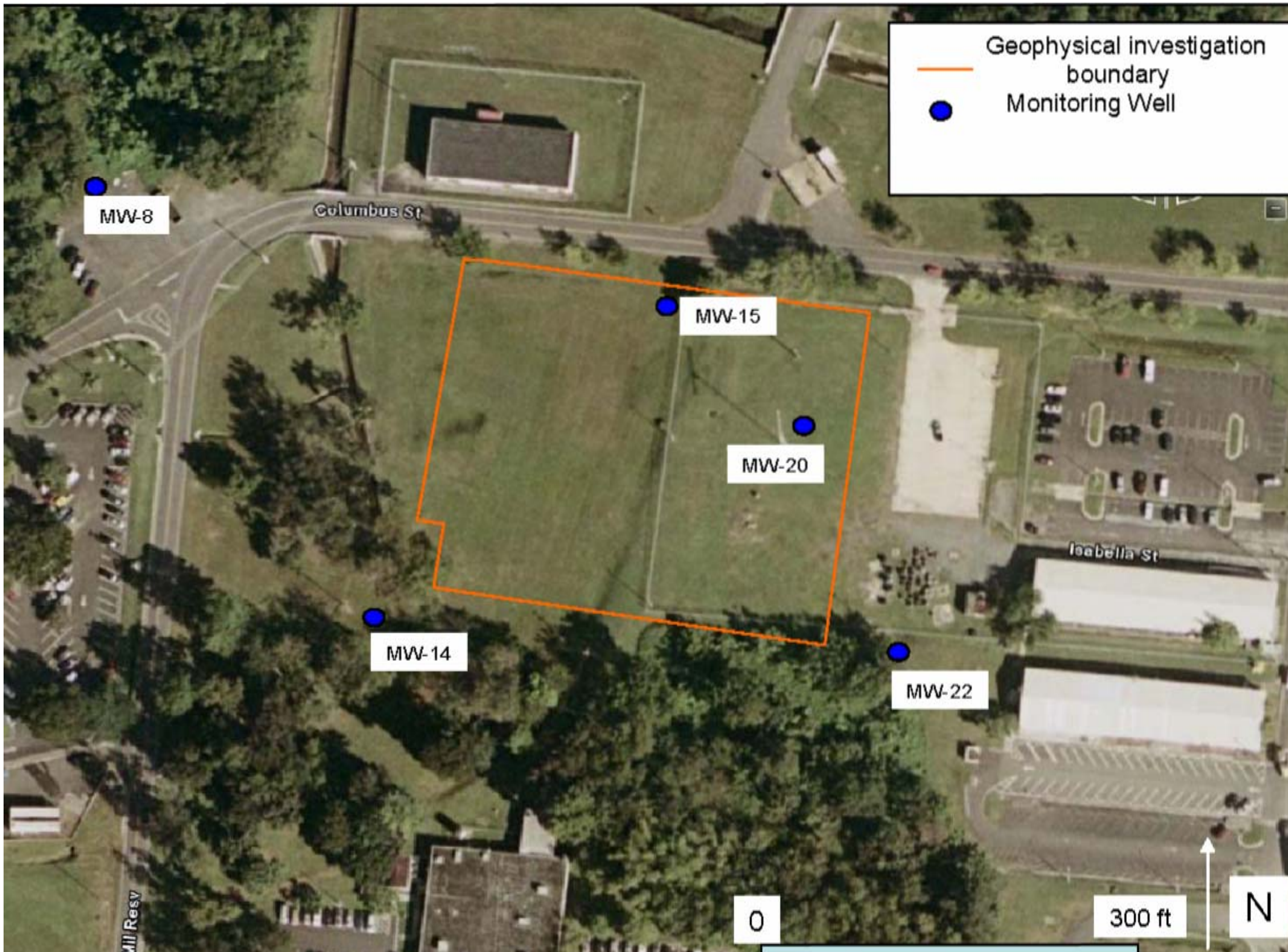
If you have any questions about the enclosed geophysical report and/or figures, feel free to contact me at 410-538-8202 ext. 1400, or at sdobson@eaest.com.

Sincerely,

Scott Dobson

Scott Dobson
Project Manager

Attachment



Geophysical Investigation Location Map

Figure 1

Fort Buchanan, Puerto Rico

Attachment A

Geophysical Survey Results
Fort Buchanan, Puerto Rico

By

Earth Resources Technology, Inc.

10810 Guilford Road, Suite 105
Annapolis Junction, MD 20701
Phone: 301-361-0620
Fax: 301-361-0659
www.ERTCorp.com

August 6, 2008

Scott Dobson
EA Engineering, Science and Technology, Inc.
11019 McCormick Road
Hunt Valley, MD 21031

Re: Results of Geophysical Surveys at Fort Buchanan, Puerto Rico

Dear Mr. Dobson,

Earth Resources Technology, Inc. (ERT) performed a geophysical survey at the above referenced site on July 21 through July 23, 2008 for EA Engineering, Science and Technology, Inc. The purpose of this investigation was to determine the presence or absence of subsurface anomalies. The area of investigation was approximately 160000 sq. ft. Both magnetic and electromagnetic surveys were conducted in the area, followed by a ground penetrating radar (GPR) survey.

1.0 Equipment

A Geometrics Portable Cesium Magnetometer, Model G-858, was used for the magnetic survey. Using self-oscillating split-beam Cesium vapor (non-radioactive Cs-133), this magnetometer measures the earth's total geomagnetic field (magnetic flux density) at a particular location in units of nannoTeslas (nT) with an accuracy of ±1.0 nT. It collects a maximum of 10 magnetic readings per second. The total field consists of three components: the main field of the earth, the external field caused by the sun and moon, and local variations caused by objects at the site. The main field and external field normally remain relatively constant over the period of time of a field investigation. Local variations are attributable to anomalies near the surface such as buried metal objects or above ground objects containing ferrous metal. Figure 1 shows a contour map of typical magnetic data containing a confirmed UST. This figure is provided to show what to look for when interpreting a magnetic survey, and *does not contain data collected at this site*.

The approach to interpreting magnetic data is to distinguish the local variations from the background. To interpret the data, readings collected from the survey grids were used to construct contour maps. Anomalies often occur as closed or elongated contours that have readings either above or below the background.

A Geonics EM31 was used for an electromagnetic (EM) survey. The EM31 measures changes in ground conductivity using an electromagnetic inductive technique that makes measurements without electrodes or ground contact. The unit of conductivity used is millisiemens per meter (mS/m). The conductivity changes are used to infer geological variations, or groundwater contamination. The EM31 has two analog meters, which display the quadrature-phase (conductivity) and in-phase components, respectively. In-phase measurements are the ratio of the induced secondary magnetic field to the primary magnetic field in parts per thousand (ppt). The in-phase component is especially useful for searching for buried metal drums, pipes, and other ferrous and non-ferrous metallic debris. The effective depth of exploration of the equipment is about twenty (20) feet. EM measurements were taken in continuous mode collecting approximately 5 readings per second, and covered the entire grid.

The EM data were collected to identify man made features and support the magnetometer results. Unlike the G-858, the EM-31 is able to detect both ferrous and nonferrous metals. It is also able to detect old stream beds or trenches. This makes it a very useful tool when investigating environmental spills and local contaminations.

The SIR-3000 Ground Penetrating Radar unit, manufactured by Geophysical Survey Systems, Inc. (GSSI), was used to conduct the GPR survey. The device radiates a polarized electromagnetic wave from a transmitter antenna into the earth and receives at a receiving antenna the reflection of the wave from subsurface interfaces at which changes in the electrical properties (dielectric permittivity and electrical conductivity) of the subsurface materials occur. Dielectric permittivity controls wave speed; and conductivity determines the signal attenuation. Radar reflections occur when the radio waves encounter a change in the velocity or attenuation. The greater the change in properties the more signal is reflected. These properties may be controlled by the water content of the material. Also, metallic objects usually exhibit a strong subsurface reflection due to their high electrical impedance or contrast versus surrounding soil or fill. Depth of penetration of the radar signal is inversely proportional to the conductivity of the soil. As a result, electrically resistive earth materials such as coarse-grained, unsaturated sediments allow a deeper radar penetration than the conductive finer-grained soils such as clay and silt. Similarly, reinforced concrete and shallow groundwater are conductive and thus attenuate the radar signals. The 400 MHz antenna was used for this survey.

The collection of the GPR data was performed by pulling the antenna along, and between, grid lines while the positions of each radar reading were recorded with an odometer attached to a survey wheel. The odometer was set up such that 10 radar readings would be acquired every foot. The average velocity of the radar is estimated to be around 0.1 m (0.328 feet) per nanosecond (ns). The time range selected was 80 ns, and such a time range would allow a penetration depth of over 12 feet. However, the profiles displayed in this report were cropped at 47 ns (about 7.6 feet) because no features were evident on the profiles below that depth. The GPR data were recorded digitally in a portable computer for instant display and subsequent processing. An example of a UST seen in a GPR profile is provided in Figure 2. GPR data provided in Figure 2 *is not from this site.*

Each GPR profile is made of a series of individual "wiggle traces" that have crests and troughs. A GPR profile is constructed by color-coding the crests and troughs of traces and aligning them side-by-side. As shown in the profiles of Figure 2, the white reflections are crests of individual traces with the highest (positive) amplitudes, while the dark grey-black reflections are the troughs of individual traces with the lowest (negative) amplitudes. The whitest and blackest reflections are created by interfaces of the highest dielectric contrast. The color scheme in Figure 7 is somewhat different – red indicates strong positive amplitudes and blue strong negative amplitudes, with white indicating zero amplitude.

Interpretation of GPR data is focused on analyzing the reflections created by subsurface objects. On a GPR profile, a cylindrical subsurface feature may be represented by strong hyperbolic reflections in its cross-section and by strong horizontal reflections terminating at both ends in its longitudinal profile. Tanks will often create strong reflectors. Similarly, pipes or drainage tile will have hyperbolic reflections, but should be smaller and perhaps less intense than those caused by a tank (see Figure 2). It is also important that reflectors repeat in adjacent profiles. Single, non-repeating reflectors may be caused by insignificant natural features (rocks, tree roots, etc.).

2.0 Results

2.1 Magnetic Results

A grid was laid out at the site, with the origin at [100,100] in the south western corner of the site. The grid was later expanded to the west 30ft to include features found in preliminary surveys. Figure 2 shows a site map with features labeled. Figure 3 shows a magnetic contour map with the site features as reference in the background. There were only two magnetic anomalies present on the survey site that did not correlate with surface features. The biggest anomaly is labeled magnetic anomaly **A**, and is located in the northwest area of the site. This anomaly is larger than an average UST but its size, shape and intensity indicates that it could be old trenches or depressions that have been filled, or a former debris burial site. Magnetic anomaly **B** is located in the south western part of the survey area and is about 10ft by 10ft. This anomaly does line up with an old railroad track which could explain its presence, however, given its size and shape this anomaly could be representative of a UST and therefore is an area of concern.

2.2 Electromagnetic Results

The Electromagnetic survey was conducted over the entire site and the results are depicted in two figures. Figure 4 shows the quadrature data which measures conductivity in millisiemens per meter. This figure confirms the presence of both magnetic anomalies **A** and **B**. It also shows a linear feature running from the center of the survey area to the south west. This feature is easier seen on the in-phase figure and is associated with a known sewer line. There is also a weaker linear feature starting in the western area of the grid and trending south east, which is probably caused by a former trench. Figure 5 shows the in-phase EM data which is measured in ppt. This figure confirms the existence of magnetic anomalies **A** and **B**. Using the in phase data also clearly depicts the previously mentioned sewer line. There is also a faint linear trend starting at 200,100 and trending north east. This anomaly is most likely caused by a former trench or local utilities. There is also a faint anomaly that is located approximately 50ft east of, and parallel to the fence. This anomaly, which is visible in both quadrature and in-phase maps, is associated with a possible abandoned rail road line.

2.3 GPR Results

GPR lines were collected over magnetic anomalies **A** and **B** as well as over other large magnetic anomalies. Figure 6 shows the locations where GPR profiles were collected over the survey area. GPR profiles that have been labeled with letters are displayed in Figure 7. Profiles **A-A'** and **B-B'** show GPR anomalies that are associated with the magnetic anomaly **A**. Theses profiles depict a general subsurface disturbance which underlies this entire anomalous area. There are also a few scattered sharp hyperbolic reflectors which would most likely be caused by small buried metallic objects or metallic rocks. Profiles **C-C'** and **D-D'** show GPR anomalies that are associated with the magnetic anomaly **B**. Although this anomalous area lines up with an old railroad line it does seem to be confined to a small 10ft by 10ft area less than 2 ft deep which could represent an area of concern. However, the GPR response does not appear to be representative of a typical UST or buried drum. Profiles from other areas that were investigated using GPR, which are not included in this report, do not show any significant anomalies except those which confirm surface features.

Figure 8 displays the areas where anomalies were located. The red rectangles indicate the area where the GPR located a structure in the shallow subsurface.

3.0 Closing

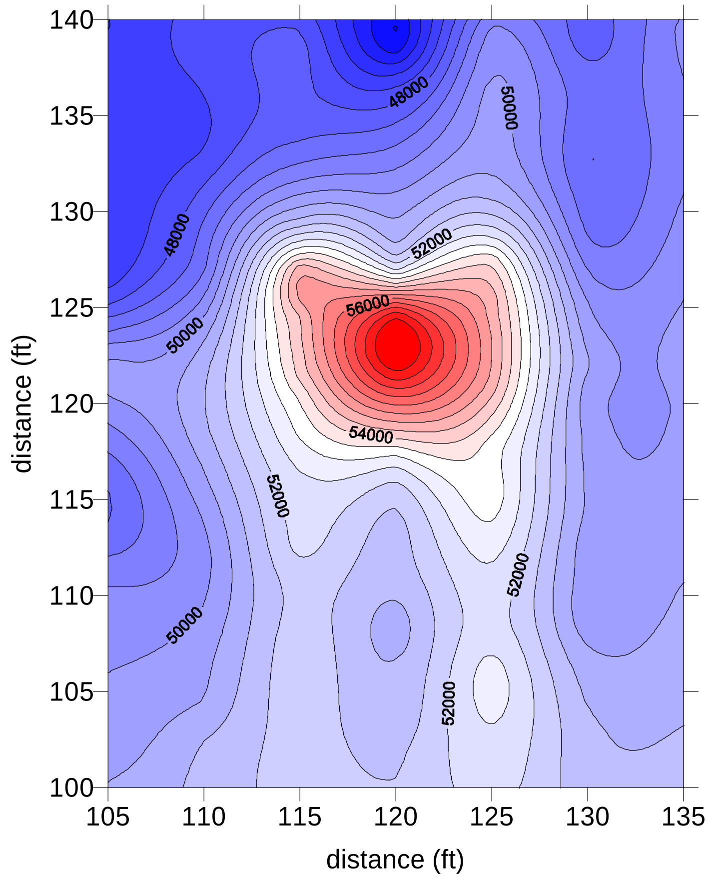
This investigation identified two magnetic anomalies with nearly coincident electromagnetic and GPR anomalies in the shallow subsurface. Magnetic Anomaly A, in the northwestern corner of the survey area seems to be a large area of general disturbance which could be a buried debris field. Magnetic Anomaly B, in the southeastern corner of the survey area, is most likely related to the former railroad line.

If you have any questions please contact me at 301-323-1429.

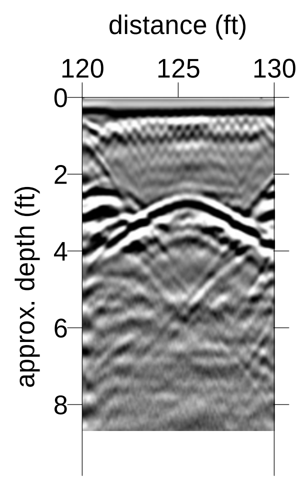
Sincerely,
Earth Resources Technology, Inc.

James L. Stuby, M.S., P.G.
Project Geophysicist

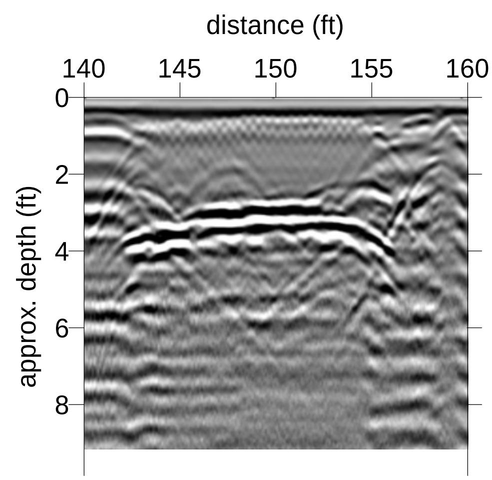
Attachment: Disclaimer
Figures 1 - 8



Magnetic Flux Density Contour Map
showing central anomaly (red) indicative of possible UST
500 nT contour interval



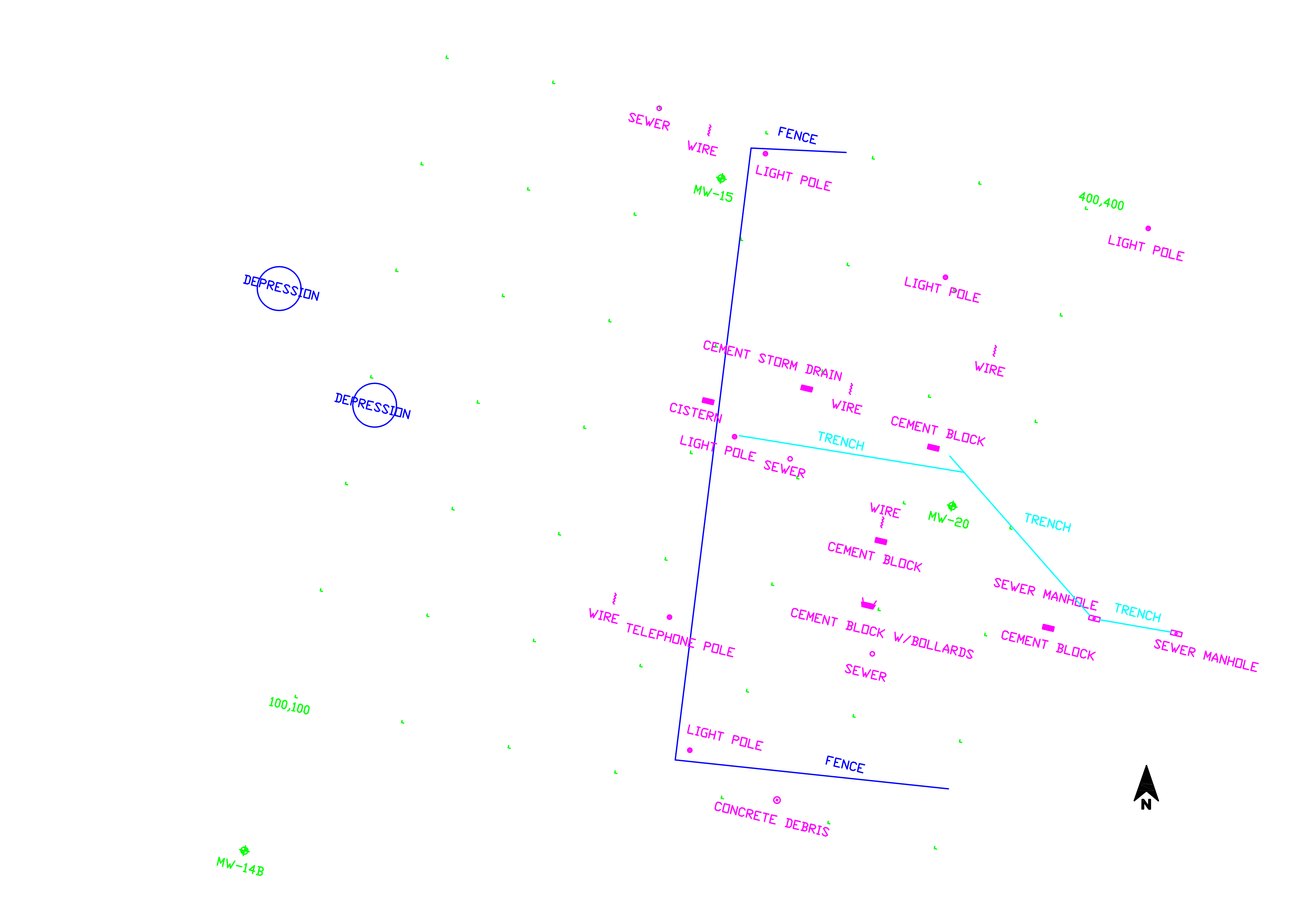
cross-section



longitudinal section

Profiles acquired over a confirmed modern UST with 400 MHz antenna.

ERT EARTH RESOURCES TECHNOLOGY	EXAMPLE OF MAGNETIC ANOMALY (TOP) AND GPR PROFILES (BOTTOM) REPRESENTING UNDERGROUND STORAGE TANKS (Not from this site)	FIGURE 1 updated Dec. 1, 2006 SCALE: as shown



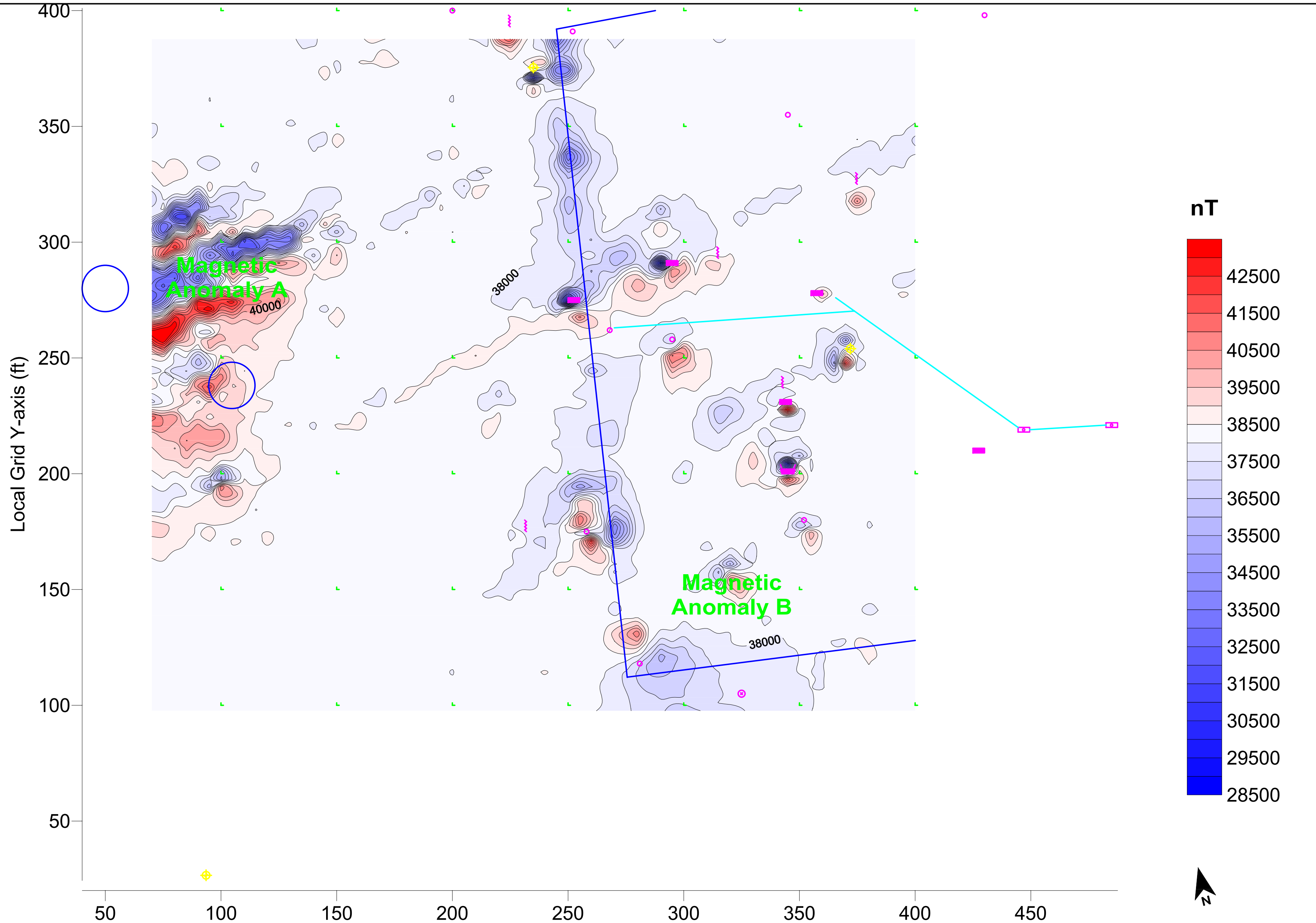
EARTH
RESOURCES
TECHNOLOGY

SITE MAP
Fort Buchanan, Puerto Rico

FIGURE 2

August 4, 2008

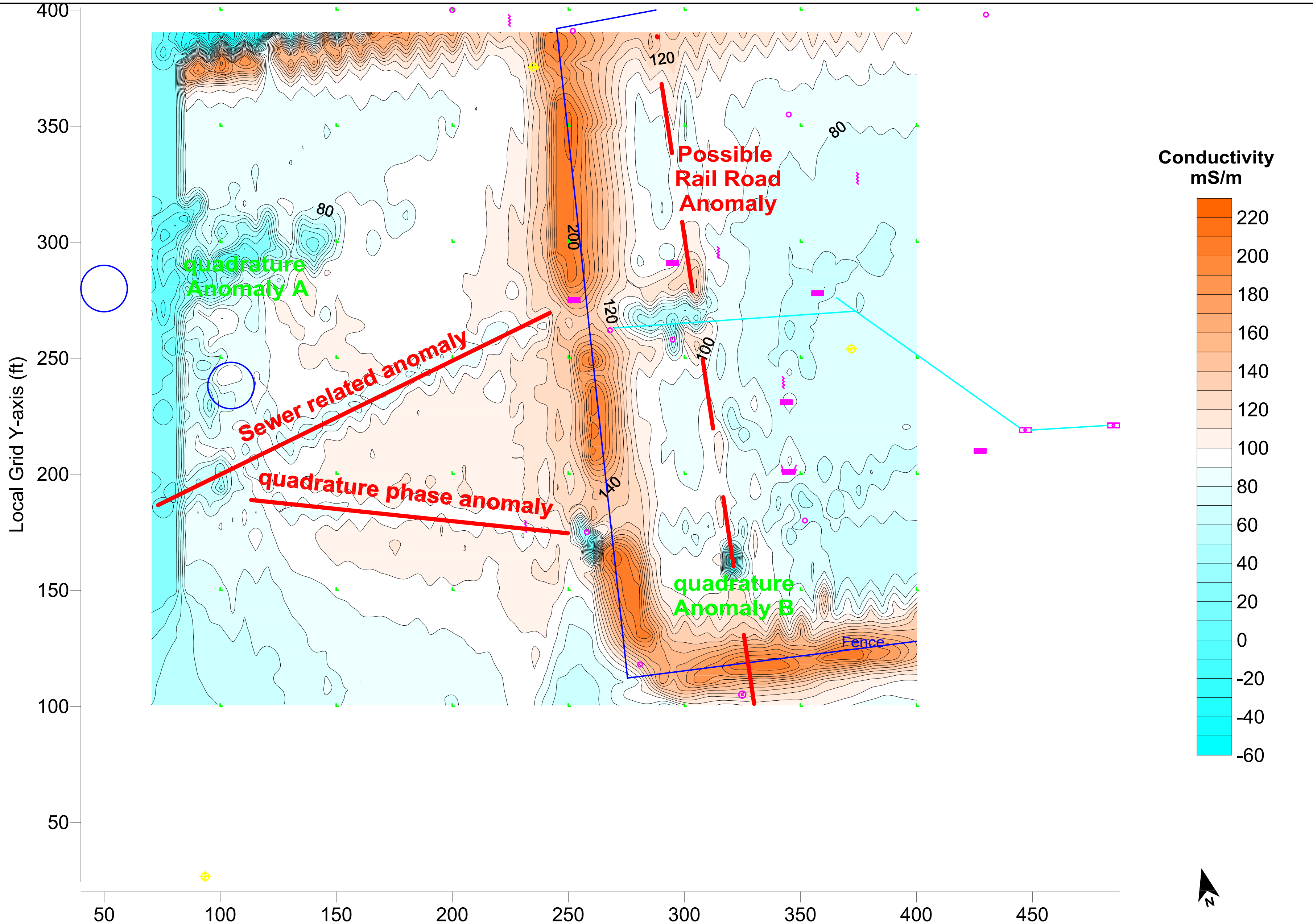
SCALE: 1" = 60'



Magnetic data acquired ~ 10:30 am local time July 22, 2008, using Geometrics G-858 magnetometer.

Contour Interval = 500 nT

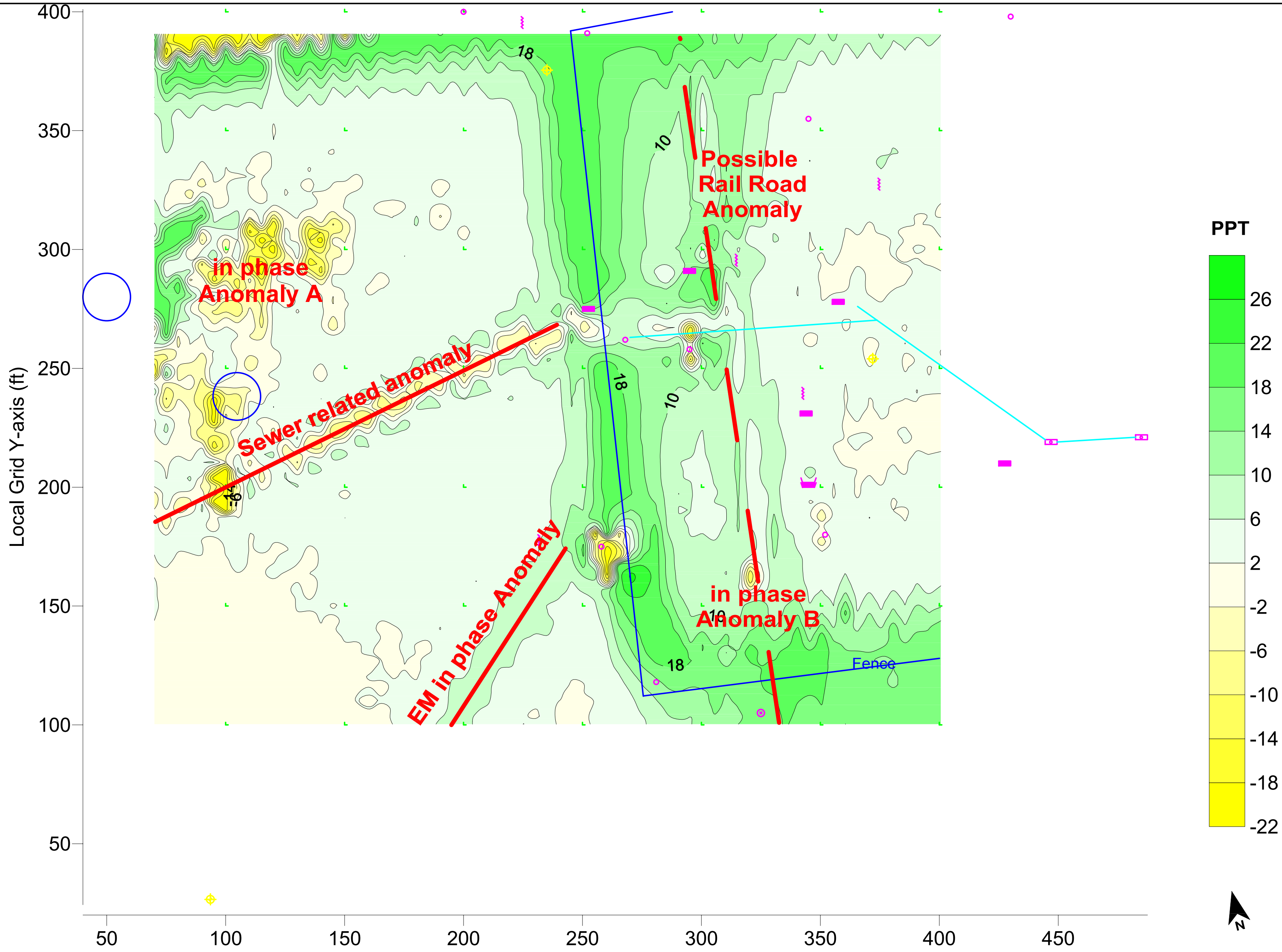
EARTH RESOURCES TECHNOLOGY	MAGNETIC CONTOUR MAP Fort Buchanan, Puerto Rico	FIGURE 3 August 4, 2008 SCALE: 1" = 60'



Electromagnetic data acquired July 22, 2008,
using Geonics EM31.

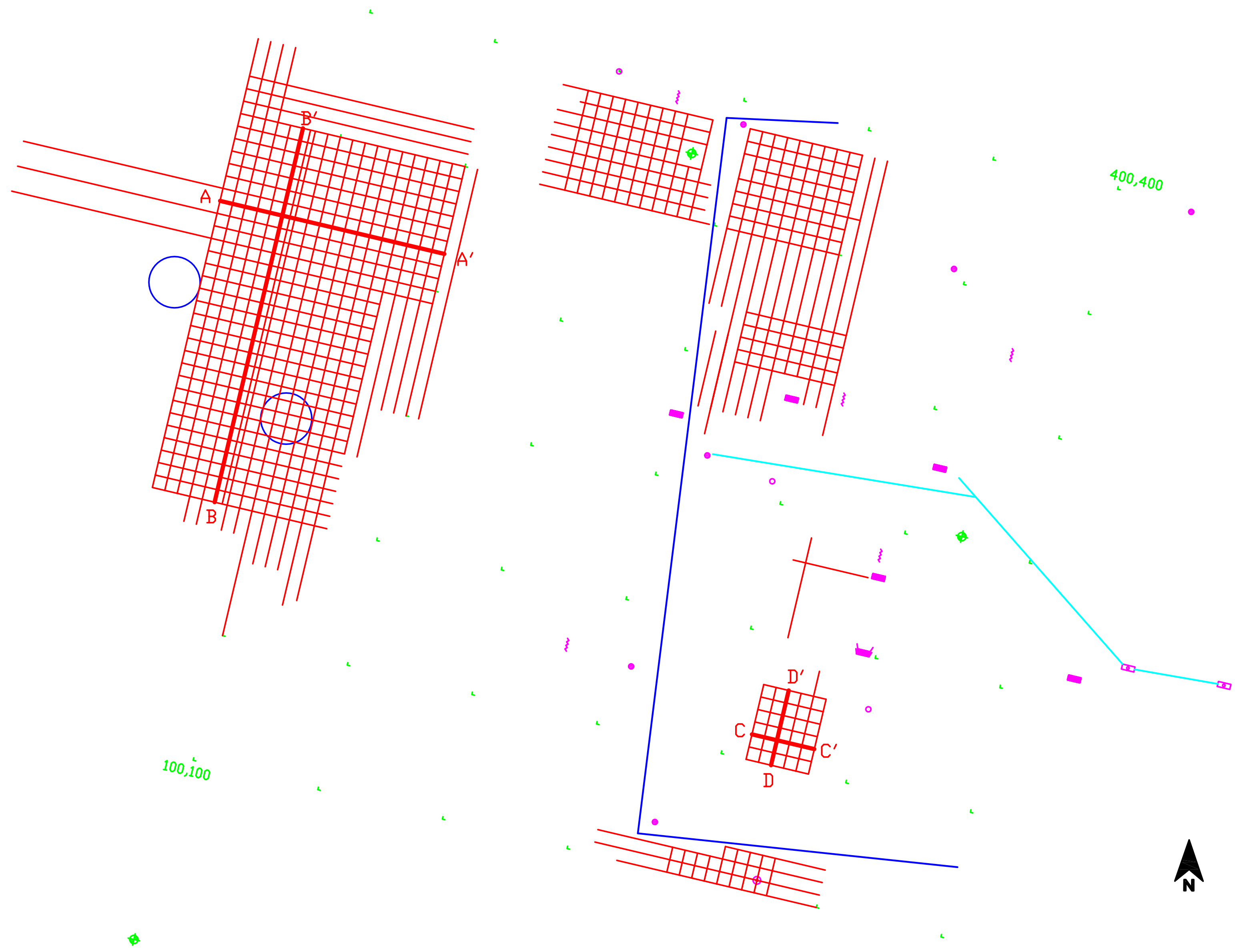
Contour Interval = 10 mS/m

EARTH RESOURCES TECHNOLOGY	ELECTROMAGNETIC CONTOUR MAP quadrature (Ground Conductivity Response) Fort Buchanan, Puerto Rico	FIGURE 4 August 4, 2008 SCALE: 1" = 60'



Electromagnetic data acquired July 22, 2008, using Geonics EM31.

EARTH RESOURCES TECHNOLOGY	ELECTROMAGNETIC CONTOUR MAP In Phase response Fort Buchanan, Puerto Rico	FIGURE 5 August 4, 2008 SCALE: 1" = 60'



EARTH RESOURCES TECHNOLOGY

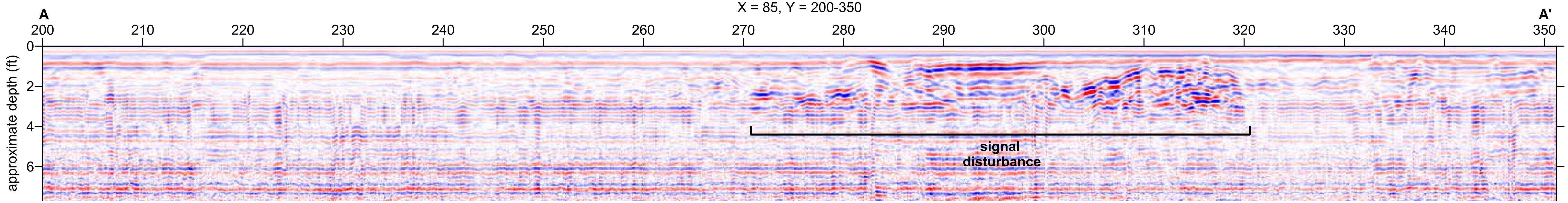
GPR LOCATIONS
Fort Buchanan, Puerto Rico

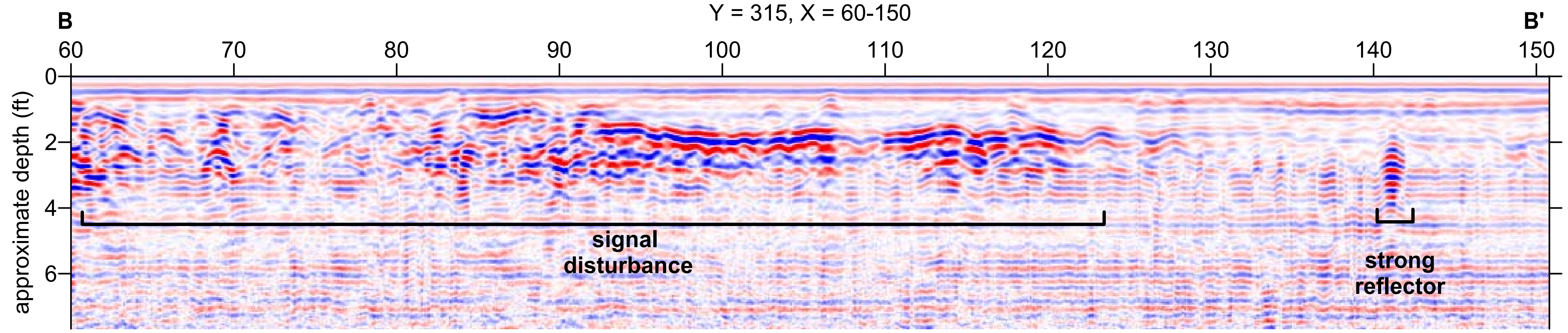
FIGURE 6

August 4, 2008

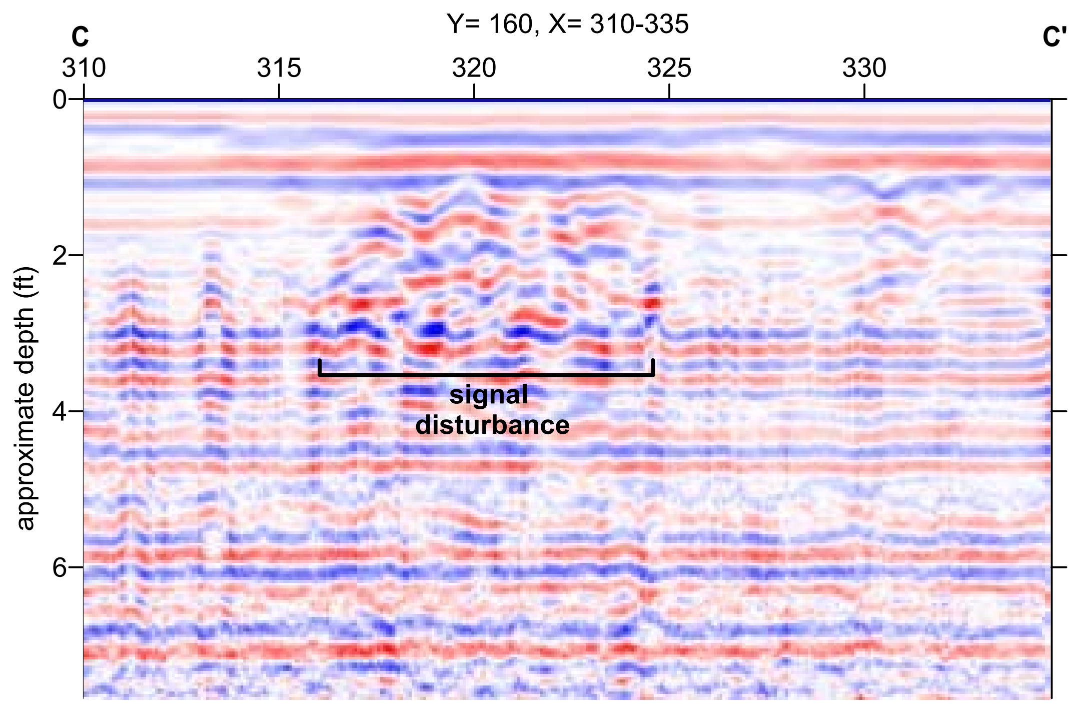
SCALE: 1" = 60'

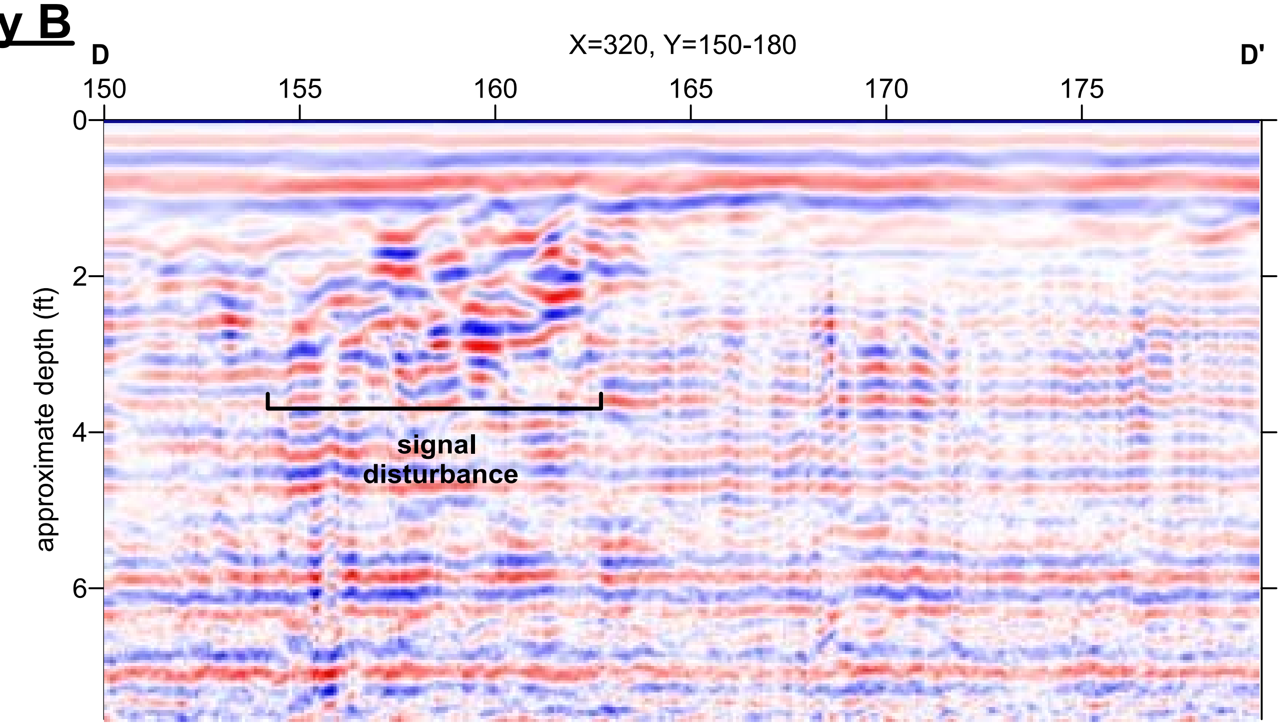
Anomaly A





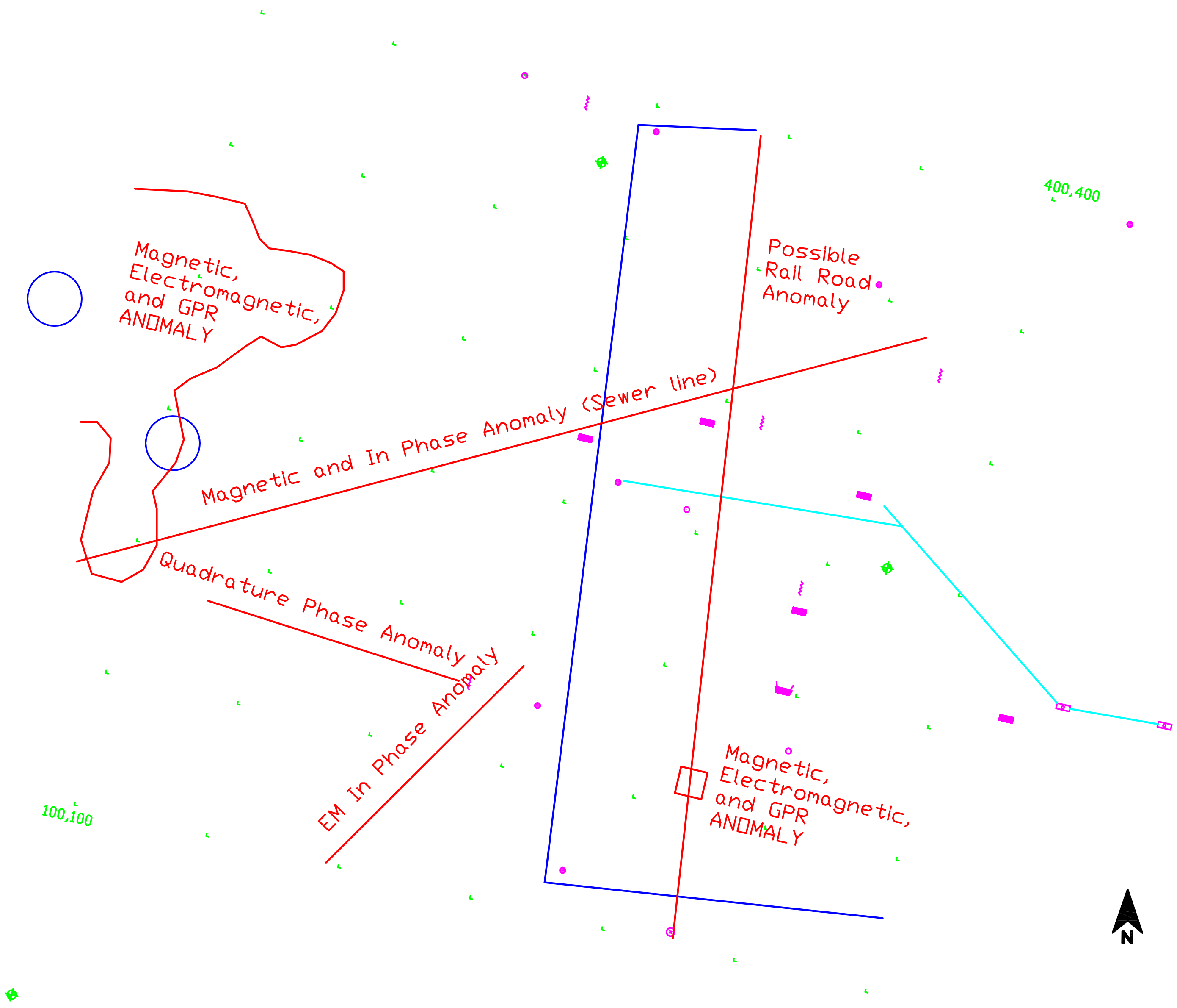
Anomaly B





GPR profiles collected with GSSI SIR-3000 with 400 MHz antenna on July 23, 2008. Horizontal axis shows distance in feet using local grid coordinates. Vertical axis shows approximate depth in feet. See figure 6 for profile locations. Vertical scale exagerated 2X.

EARTH RESOURCES TECHNOLOGY	GPR PROFILES Fort Buchanan, Puerto Rico	FIGURE 7 August 4, 2008 Horizontal scale, Anom. A: 1"=10' Horizontal scale, Anom. B: 1"=5'



EARTH RESOURCES TECHNOLOGY

ANOMALY LOCATIONS
Fort Buchanan, Puerto Rico

FIGURE 8

August 4, 2008

SCALE: 1" = 60'